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THE PHENOMENON OF FOAMING-OVER OF HEAVY LIQUID FUELS BURNING AT THE FREE SURFACE

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/Digest/

/The following is a brief description of the factors, under laboratory conditions, that govern the foaming-over of heavy oil burning in a container./

Subject report discusses recent experiments on the phenomenon of boiling-over characteristic of heavy oil products when burning on the surface of water in a container. Similar experiments had already been conducted in 1943 on light petroleum fuels, with the conclusion that there is rapid establishment of constant velocity of combustion and insignificant heating of the oil in the depth of the liquid, with the result that a light fuel on top of water in a container burns quietly.

Later and recent tests with heavy oils show that they heat up continuously within the depths of the oil as the surface burns, that is, they do not acquire the stationary, and comparatively insignificant, vertical temperature gradient which is typical of light fuels. Heat penetrates the depth of the heavy oil and causes the formation of steam which, as in the geyser phenomenon, expands and ejects the oil and its burning surface layers.

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The significant factor is the water content of the heavy oil, which causes the foam and subsequent foaming-over of the oil. A relation is established between the volume of foam generated by one kilogram of heavy oil at 100° C and the moisture content w (0 to 8%). Volume is found to increase as much as 1,763 times. A dozen different heavy oils are tested and classified in one of two types: (a) explosive with instantaneous ejection of the total quantity of oil; (b) formation of stable foam and foaming-over.

/Table follows/

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Foaming of Fuel Burning in Laboratory Apparatus on Top of Water Surface

Petroleum Product	Liquid Fuel Temp Before Expt (in °C)	Thickness of Liq Fucl Layer (mm) Before Expt	Before Foaming Over	Avg Temp of Upper Layer (in °C)	Rate of Burning (mm/min)	Time in Which Foaming Over Occurs (min)	Type of Foaming Over	Remarks
Benzene distillation head	22	140	-	78	3.8	Does not occur		
Automobile gasoline	25	157	-	153	2.4	" " "		
Kerosene	25	146	-	208	1.5	" " "		
Solar oil	26	160	8.2	285	1.15	132	Boiling accompanied by spraying	
Transformer oil	25	140	30.8	410	1.05	104	Weakly explosive	Multiple ejection with violent spraying of burning oil
Crude petroleum (dry)	29	136	71.6	340	1.70	32	Explosive	
Crude petroleum (5% moisture)	29	140	122.4	305	1.60	]	Foaming	
Fuel mazut (dry)	32	150	78	395	1.80	40	Explosive	Momentaneous ejection of total quantity of mazut

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Petroleum Product	Liquid Fuel Temp Before Expt (in °C)	Thickness of Liq Fuel Layer (mm) Before Expt	Before Foaming Over	Avg Temp of Upper Layer (in °C)	Rate of Burning (mm/min)	Time in Which Foaming Over Occurs (min)	Type of Foaming Over	Remarks
Fuel mazut (6% moisture)	32	160	136.2	320	1.70	14	Foaming	Until flame extinguished
Water-free heavy mazut	35	140	98	502	0.95	44	Explosive	Momentaneous ejection of total quantity of mazut
Heavy mazut (7% moisture)	35	144	130.4	419	0.91	15	Foaring	Until flame extinguished

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- 4 -

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